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STOMACH CONTENT ANALYSIS OF TROLL-CAUGHT SALMON IN SOUTHEASTERN ALASKA

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UNITED STATES DEPARTMENT OF THE INTERIOR
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STOMACH CONTENT ANALYSIS OF TROLL-CAUGHT KING AND COHO SALMON, SOUTHEASTERN ALASKA, 1957-58

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Gerald M. Reid

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STOMACH CONTENT ANALYSIS OF TROLL-CAUGHT KING AND COHO SALMON, SOUTHEASTERN ALASKA, 1957-58

By

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ABSTRACT

Stomach samples of king salmon *(Oncorhynchus tshawytscha)* and coho salmon *(Oncorhynchus kisutch)* were collected from the commercial troll fishery of Southeastern Alaska in 1957 and 1958.

Herring accounted for the largest percentage of the five organisms eaten most frequently by both species of salmon.

The diet of coho salmon was found to be much more varied than that of king salmon. Differences in the salmons' diet between four geographic areas of Southeastern Alaska and differences occurring in relation to the size of the salmon were analyzed and described.

INTRODUCTION

Over the past 30 years the number of troll-fishing vessels in Southeastern Alaska has nearly doubled, but the landings of these vessels, primarily king *(Oncorhynchus tshawytscha)* and coho *(O. kisutch)* salmon, fishermen asserted, have continuously declined. The suggestion has been made that a possible reason for the decline is the depletion of the salmon's food supply brought about by the commercial purse-seine fishery for herring in a number of the troll-fishing areas.

Similar suggestions were made in the State of Washington for the pilchard fishery (Chapman, 1936) and in British Columbia for the herring fishery (Pritchard and Tester, 1944). Analyses of the stomachs of king and coho salmon in those areas demonstrated that these salmon have a generally varied diet, and that the relative importance of food items fluctuates between years and by geographical location.

In 1957 the Bureau of Commercial Fisheries began a study of stomach contents of troll-caught king and coho salmon in Southeastern Alaska. The program was carried on during the commercial fishing season and was primarily aimed at determining the relative importance of herring and other food items in the diet of the two species studied.

The study was designed to gain basic information on the diet of troll-caught salmon in Southeastern Alaska by examining the occurrence of food

items taken: (1) by season, (2) by geographical area, (3) by species of salmon, and (4) by lengths of salmon.

Donald T. Montgomery measured and counted a large part of the stomach material, and Dr. Norman J. Wilimovsky identified a number of the organisms. We appreciate the cooperation of the commercial troll fishermen for their aid in the study.

METHODS AND MATERIALS

The proposed sampling program was discussed with commercial troll fishermen in several communities of Southeastern Alaska. A reward of $1 was offered for each salmon stomach collected and sent to the Bureau of Commercial Fisheries Laboratory in Juneau with accompanying collection data. Table 1 lists the names and home ports of the vessels participating in the study.

Stomachs of king and coho salmon were collected each season from mid-June to mid-September. Fishermen were instructed to collect over as wide an area as possible at a rate of one or two stomachs per day. The distribution of the collections was grouped into four areas, designated I, II, III, and IV, for purposes of analysis (fig. 1). Percentages of the troll-caught salmon stomach samples from each area are given in figure 2.

Each troller was supplied with the following equipment: small cloth bags in which to place stomachs, 25-pound fir fish kegs for holding stomachs, waterproof identification tags, measuring sticks marked in 2.5-inch colored sections, and enough formalin to make 4 gallons of 10-percent solution. Fishermen were asked to record the following data on the tag provided for each stomach collected: (1) date of capture, (2) location of catch, (3) species, and (4) fork length. The tag was placed in the bag with the stomach, and the bag was dropped into the keg of preservative. When 25 stomachs had been collected, the keg was shipped to the laboratory in Juneau.

TABLE 1.--Number of stomachs of king and coho salmon returned by commercial troll vessels, Southeastern Alaska, 1957-58

Home port and vessel	Number of stomachs
Ketchikan:	
Garland	25
Red Angel	25
Argo	24
Petersburg:	
Ukum	93
Pegge	49
Ava	30
Craig:	
31B387	50
Omar	49
31D479	24
Sitka:	
Elk	65
Myrth	25
Photographic	21
Pelican:	
Edrie	25
Betty J.	24
Olive T.	13
Elfin Cove:	
Lunar	100
Juneau:	
Real George	131
Puppy	23
Total	796

A total of 850 stomachs were received, 374 of which were from king salmon, 422 from coho, 7 from pink *(O. gorbuscha)*, 1 from chum *(O. keta)*, and 46 from salmon of undetermined species. The stomachs were opened, the contents measured volumetrically, and the organisms identified and counted. Analysis was made only on the 796 stomachs from king and coho salmon; of these, 201, or 25.2 percent, were empty.

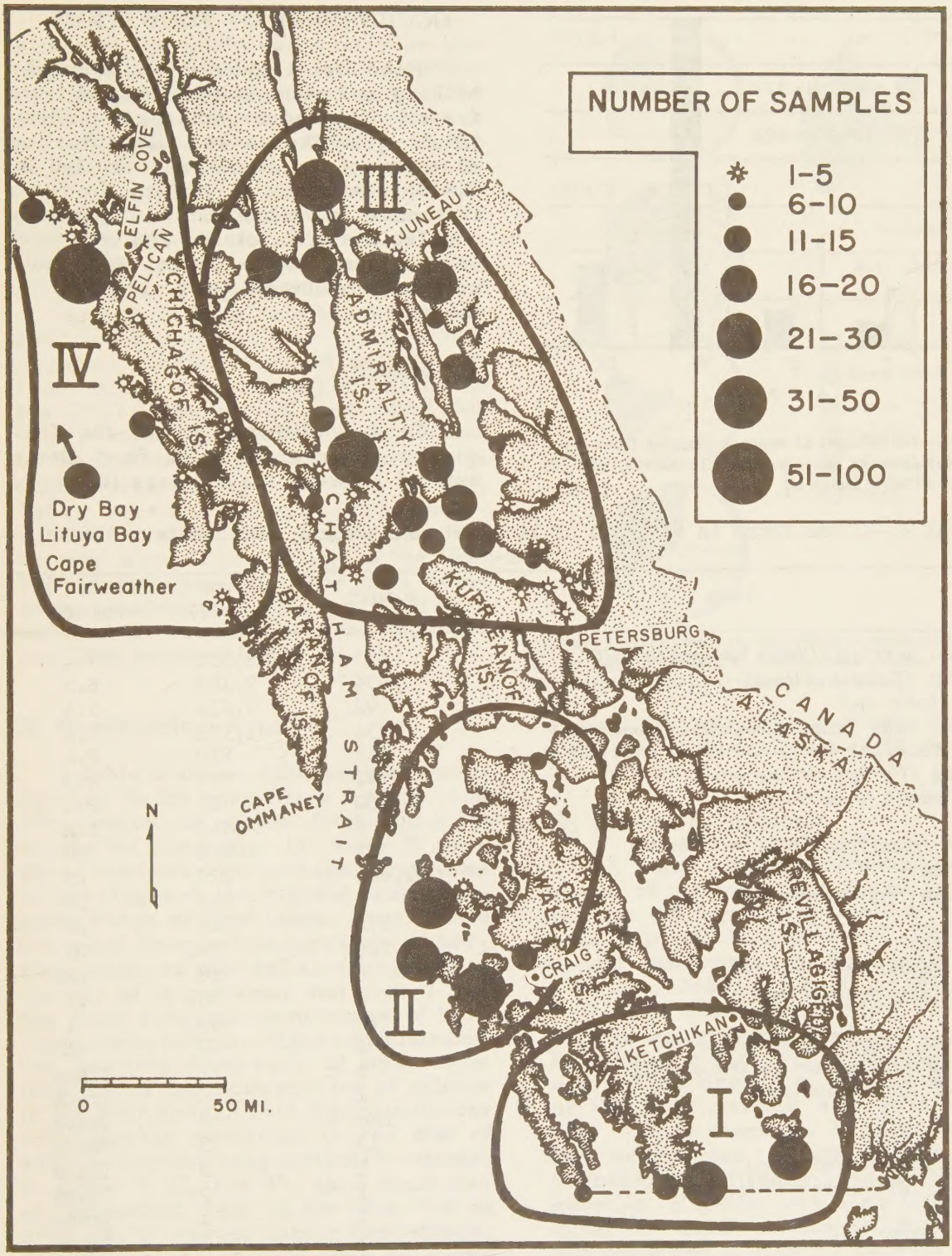

Figure 1.--Locations of capture of king and coho salmon from which stomach samples were taken in Southeastern Alaska, 1957-58.

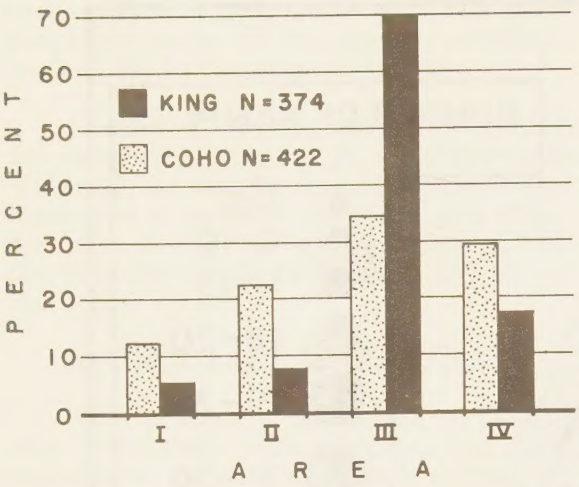

Figure 2.--Percentages of stomach samples from troll-caught salmon by area, Southeastern Alaska, 1957-58. [Areas shown in figure 1.]

OCCURRENCE OF FOOD ITEMS

Food items found in the stomachs of king and coho salmon ranged from freshly ingested organisms to unidentifiable jellylike masses. Classification of many of the items was limited by the degree of disintegration. In some instances identification of organisms was facilitated by otolith and vertebral comparisons. Items found and their relative volumes are listed in table 2.

By Season

Certain differences in the frequency of occurrence of food items existed between the 2 years (table 3).

TABLE 2.--Items found in stomachs of king and coho salmon, Southeastern Alaska, 1957-58

Item	Number	Volume (in cc.)	Percent by volume
Pacific herring *(Clupea harengus pallasi)*	453	22,551	67.4
Capelin *(Mallotus villosus)*	454	2,183	6.5
Squid *(Loligo sp.)*	92	1,814	5.4
Pacific sand lance *(Ammodytes hexapterus)*	734	1,552	4.6
Widow rockfish *(Sebastodes entomelas)*	165	810	2.4
Whiting *(Theragra chalcogrammus)*	52	775	2.3
Other smelt *(Osmeridae)*	200	713	2.1
Bait[1]	8	412	1.2
Pacific sandfish *(Trichodon trichodon)*	57	218	.6
Amphipod	1,604	179	.5
Prowfish *(Zaprora silenus)*	1	165	.5
Shrimp	575	118	.4
Euphausid	726	59	.3
Dolly Varden *(Salvelinus malma)*	2	58	.2
Salmon *(Oncorhynchus spp.)*	1	50	.1
Mysid	70	50	.1
Northern ronquil *(Ronquilus jordani)*	1	30	.1
Lanternfish *(Lampanyctus leucopsarus)*	1	11	Trace
Ronquil *(Bathymasteridae)*	1	9	Trace
Snail	286	9	Trace
Larval crab	13	3	Trace
Lumpsucker *(Cyclopteridae)*	1	3	Trace
Ratfish *(Hydrolagus colliei)*	1	2	Trace
Isopod	1	1	Trace
Nereid worm	1	1	Trace
Shell	1	1	Trace
Wooden stick	1	1	Trace
Bird feather	1	1	Trace
Unidentifiable		1,666	5.0

[1] Small fillets of herring obviously prepared by fisherman; undigested apparently as a result of a fixative used in their preparation.

Although the differences may be entirely an artifact of the sampling method and consequently must be approached with caution, they are nonetheless of considerable interest. Several of the items seem to appear more often in one year than in the other. Widow rockfish were found in 9.2 percent of the coho salmon stomachs collected in 1958 but did not appear in the 1957 collections. Frequency of occurrence of herring in king salmon was less in 1957 (40.0 percent) than in 1958 (56.7 percent). Squid occurred in 1.3 percent of the king salmon stomachs in the 1957 samples but accounted for 13.8 percent in 1958. Euphausids, found to be taken by salmon frequently in other areas (Heg and Van Hyning, 1951), were found in none of the Southeastern Alaska 1957 collections and in only a small percentage of the 1958 collections. Several other food items show considerable differences in percent of occurrence between the 1957 and 1958 seasons (table 3).

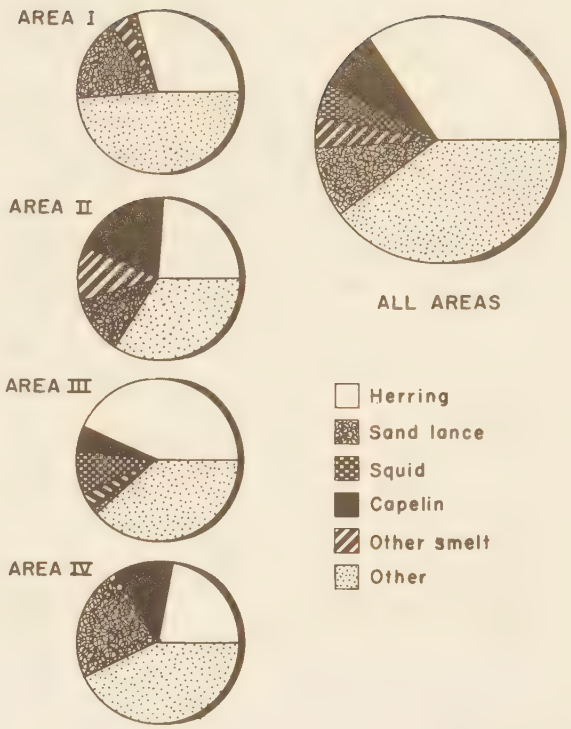

Figure 3.--Frequency of occurrence of major items found in salmon stomachs, Southeastern Alaska, 1957-58. [Based on total occurrence of food items.]

By Geographical Area

Table 4 shows differences between species in the percentage frequency of occurrence of major food items by numbered area (fig. 1). Area IV produced the lowest percentage occurrence of herring and the highest percentage occurrence of sand lance. Area III had the most frequent occurrence of herring in king salmon and also the greatest variety of organisms, and area I had the most frequent occurrence of herring in coho salmon. Figure 3 illustrates the relative frequency of five major food items for both species of salmon in the four areas. This figure indicates considerable variation in the diet of salmon between geographical locations. In areas I, II, and IV, sand lance was an important item of the diet, but in area III, it was of minor importance. Capelin, a major food item in areas II and IV, was taken incidentally in area III and did not occur in area I. Although herring appeared as a significant item in all areas, considerable differences in its use existed between areas; the greatest of these was the disparity between areas III and IV.

By Species of Salmon

A much larger percentage occurrence of herring was found in king salmon (50.5 percent) (table 4) than in coho salmon (14.9 percent). This apparent difference in food preference was also found by Senter (1940) and Pritchard and Tester (1944). The second most utilized food item in the king salmon diet was squid (8.8 percent). This organism was found in 32 of the king salmon stomachs and in only 1 coho stomach. In coho salmon, the occurrence of sand lance (12.6 percent) was slightly less than that of herring. Capelin was also frequently taken by coho salmon (10.9 percent) but occurred in only 5.1 percent of the king salmon stomachs. Figure 4 indicates the percentage of food items taken by each species of salmon by frequency of occurrence in stomachs containing food.

TABLE 3.--Differences between years and species of salmon in frequency of occurrence of food items found in stomachs of salmon collected in Southeastern Alaska, 1957-58

[Based on total occurrence of all food items]

Item	King salmon[1]				Coho salmon[2]			
	1957		1958		1957		1958	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Herring	62	40.0	123	56.7	28	18.4	35	17.9
Capelin	10	6.5	8	3.4	31	20.4	12	6.2
Squid	2	1.3	30	13.8	1	.7	--	--
Sand lance	5	3.2	11	5.1	23	15.1	29	14.9
Widow rockfish	--	--	1	.5	--	--	18	9.2
Whiting	7	4.5	2	.9	5	3.3	2	1.0
Other smelt	8	5.2	1	.5	17	11.2	3	1.5
Bait[3]	2	1.3	1	.5	3	2.0	2	1.0
Sandfish	1	.7	--	--	--	--	6	3.1
Amphipod	--	--	--	--	--	--	15	7.7
Prowfish	--	--	--	--	--	--	1	.5
Shrimp	5	3.2	1	.5	9	5.9	1	.5
Euphausid	--	--	1	.5	--	--	10	5.1
Dolly Varden	--	--	--	--	--	--	1	.5
Salmon	--	--	--	--	1	.7	--	--
Mysid	--	--	--	--	--	--	1	.5
Ronquil	--	--	1	.5	1	.7	--	--
Lanternfish	--	--	1	.5	--	--	--	--
Snail	--	--	--	--	--	--	3	1.5
Larval crab	--	--	--	--	--	--	2	1.0
Lumpsucker	1	.7	--	--	--	--	--	--
Ratfish	--	--	--	--	--	--	1	.5
Isopod	--	--	--	--	1	.7	--	--
Nereid worm	--	--	--	--	--	--	1	.5
Shell	--	--	--	--	1	.7	--	--
Stick	1	.7	--	--	--	--	--	--
Feather	--	--	--	--	--	--	1	.5
Unidentified	51	32.9	36	16.6	31	20.4	51	26.2

[1] Total of 164 stomachs examined in 1957, 210 in 1958.
[2] Total of 200 stomachs examined in 1957, 222 in 1958.
[3] Small fillets of herring obviously prepared by fishermen; undigested apparently as a result of a fixative used in their preparation.

By Lengths of Salmon

Stomach samples were received from fish ranging in length from 17.5 to 47.5 inches. Mean length of king salmon samples was 32.4 inches; mean length of coho salmon samples was 27.0 inches. Figure 5 illustrates the percentage frequency of occurrence of herring and other food items in stomachs of king and coho salmon of various lengths. For example, king salmon averaging 30 inches in length contained 56.9 percent herring and 43.1 percent other food items. Large king salmon usually contained a greater percentage of herring than did small salmon, a phenomenon that has also been observed by other investigators (Fisheries Research Board of Canada, 1954). Although samples of king salmon shorter than 22.5 inches contained no herring, those longer than 42.5 inches contained a high percentage. Stomach

TABLE 4.--Percentage frequency of occurrence, by area, of major food items in stomachs of king and coho salmon, Southeastern Alaska, 1957-58

[Empty stomachs included. See figure 1 for areas]

Item	Area I		Area II		Area III		Area IV		All areas	
	20 king	54 coho	27 king	96 coho	261 king	146 coho	66 king	126 coho	374 king	422 coho
Herring	50.0	20.4	51.9	15.6	52.9	18.5	40.9	7.9	50.5	14.9
Sand lance	5.0	18.5	7.4	12.5	1.5	.7	21.2	23.8	5.6	12.6
Capelin	--	--	7.4	26.0	4.2	5.5	9.1	10.3	5.1	10.9
Squid	--	1.9	--	--	12.6	--	--	--	8.8	.2
Widow rockfish	--	3.7	3.7	14.6	--	--	1.5	1.6	.5	4.3
Whiting	--	--	--	1.0	3.4	2.1	--	2.4	2.4	1.7
Other smelt	--	3.7	3.7	10.4	3.1	2.7	--	.8	2.4	4.0
Bait	--	3.7	--	--	1.1	1.4	--	.8	.8	1.2
Sandfish	--	--	--	1.0	.4	1.4	--	2.4	.3	1.4
Amphipod	--	--	--	--	--	10.3	--	--	--	3.6
Shrimp	--	7.4	--	1.0	2.3	2.7	--	.8	1.6	2.4
Euphausid	--	5.6	--	--	.4	1.4	--	4.0	.3	2.4
Unidentifiable	45.0	16.7	22.2	14.6	18.4	21.2	22.7	29.4	20.9	21.6
Empty	15.0	27.8	11.1	31.2	15.3	41.1	24.2	27.0	16.6	32.9

samples from coho salmon failed to show a relation between presence of herring and length of the fish. The greater use by coho salmon of food items other than herring is shown in figure 5.

IMPORTANCE OF HERRING IN DIET OF SALMON

Examination of the data suggests the following: (1) Herring are a significant food source in the diet of king and coho salmon. The importance of this item is greater in king than in coho salmon. (2) Fluctuations in diet appear to occur from year to year and by geographical area within years. (3) The diet of king salmon differs from that of coho salmon. (4) Large king salmon consume more herring than small king salmon.

Since availability of herring to the purse-seine fleet was at a high level during the 4 years from 1956 to 1959, it is assumed that general abundance of herring was also at a high level during that period. As determined by this study, during a period of high herring abundance about three-fifths (59.5 percent by occurrence per stomach) of the troll-caught king salmon sampled had utilized herring. In coho salmon, this item occurred in 22.2 percent of the stomachs sampled.

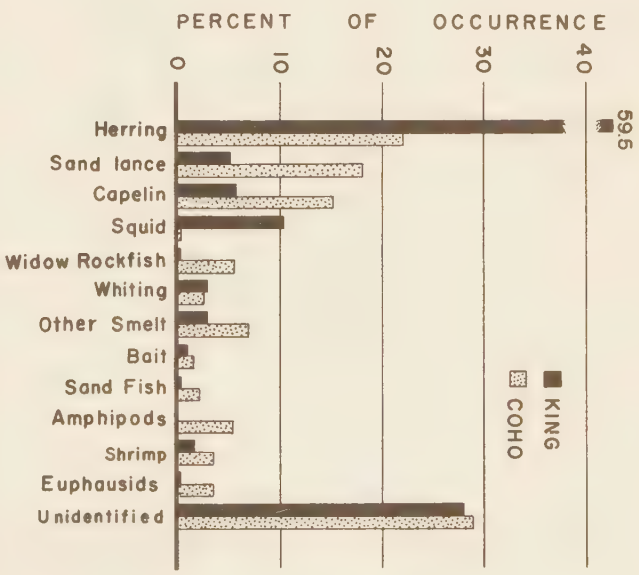

Figure 4.--Percentage frequency of occurrence of food items found in stomach samples from king and coho salmon in Southeastern Alaska, 1957-58. [Percentages based on stomachs containing food.]

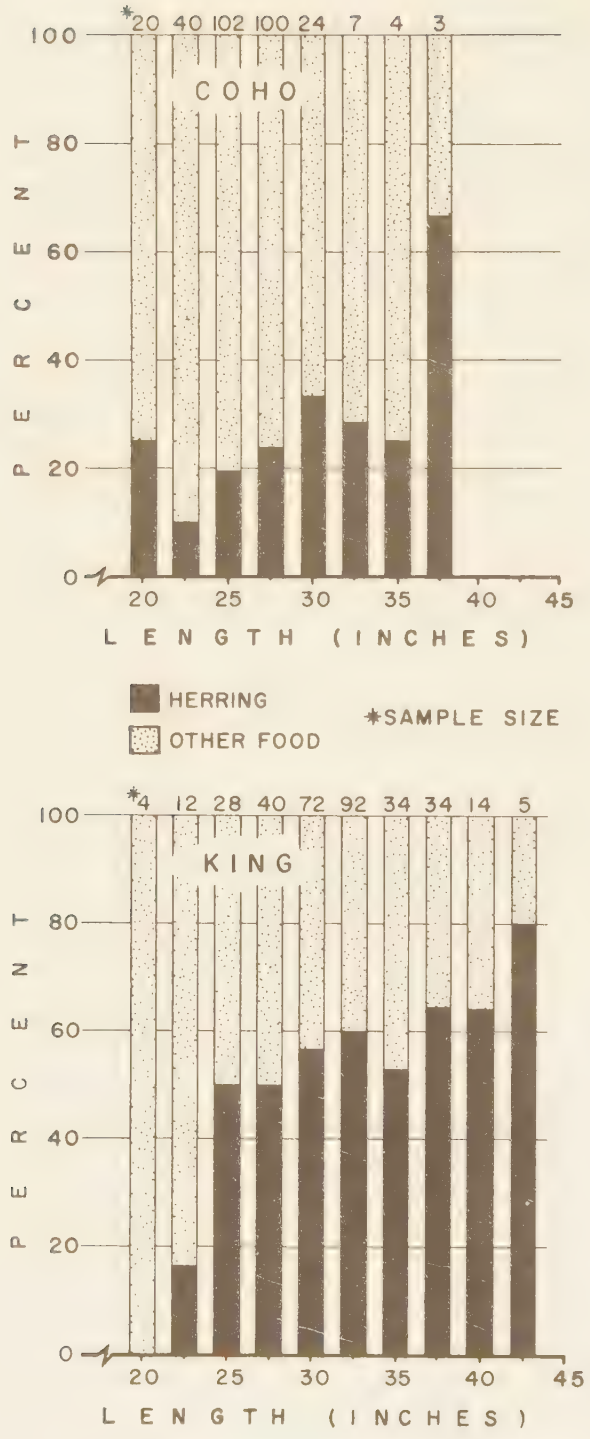

Figure 5.--Percentage frequency of occurrence in relation to length of salmon (by 2.5-inch intervals) of food items taken from stomachs of troll-caught salmon, Southeastern Alaska, 1957-58.

SUMMARY

Stomach samples from king and coho salmon were collected from the commercial troll fishery in Southeastern Alaska during the fishing seasons of 1957 and 1958. Data gathered from examination of the stomach contents are summarized in four ways: (1) percentage of volume of individual food organisms in all stomachs examined, (2) percentage of occurrence of each food organism in stomachs examined, (3) percentage of occurrence of food organisms by species of salmon, and (4) frequency of occurrence of food organisms as related to the length of king and coho salmon.

Results indicate that herring were used as food by king salmon more frequently in 1958 than in 1957, but use of this item by coho salmon was about equal for the 2 years. King salmon appear to utilize a greater percentage of herring (59.5 percent) than do coho salmon (22.2 percent). Large king salmon consume more herring than small king salmon, but such a relation is not established for coho salmon.

LITERATURE CITED

CHAPMAN, W. M.
1936. The pilchard fishery of the State of Washington in 1936 with notes on the food of the silver and chinook salmon off the Washington Coast. State of Washington, Department of Fisheries, Bulletin 36 C, p. 1-20.

FISHERIES RESEARCH BOARD OF CANADA.
1954. Report of the Pacific Biological Station. In: Fisheries Research Board of Canada Annual Report, p. 75-105.

HEG, ROBERT, AND JACK VAN HYNING.
1951. Food of chinook and silver salmon taken off the Oregon Coast. Fish Commission of Oregon, Research Briefs, vol. 3, no. 2, p. 33-40.

PRITCHARD, A. L., and ALBERT L. TESTER.
1944. Food of spring and coho salmon in British Columbia. Fisheries Research Board of Canada, Bulletin 65, 23 p.

SENTER, VANCE E.
1940. Observations on the food of Pacific salmon. Pacific Fisherman, vol. 38, no. 4, 26 p.

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